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REMARKS

Applicants thank the Examiner for the very thorough consideration given the present application. Claims 1-18 and 20 are now pending in the application. Claim 20 has been added. Claim 11 is amended. Claim 19 is canceled without prejudice to the subject matter contained therein. The amendments to the claims contained herein are of equivalent scope as originally filed and, thus, are not a narrowing amendment. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

RESTRICTION REQUIREMENT

Applicants hereby affirm the provisional election with traverse to prosecute claims 1-18. Applicants cancel claim 19 without prejudice to the subject matter contained therein.

SPECIFICATION

The specification is amended to correct obvious typographical and scrivener errors. No new matter is introduced by the amendment of the specification.

REJECTION OF CLAIMS 1, 2 AND 4-6 UNDER 35 U.S.C. § 102 AND § 103

Claims 1, 2 and 4-6 are rejected under 35 U.S.C. § 102(b) as being anticipated by Flonc (U.S. Patent No. 5,080,851) or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Flonc in view of Crane (U.S. Patent No. 4,695,344). This rejection is respectfully traversed.

The present invention relates to methods and systems for bonding two or more independ nt dry fiber prefoms to form a composite laminate structure having

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an even stronger joint between the joined surfaces of the preforms. The method generally includes taking two or more dry fiber preforms and assembling the preforms with adhesive material between those surfaces of the preforms that are to be bonded together. This is preferably accomplished with the preforms resting on a tool of a conventional vacuum assisted resin transfer molding apparatus. The preforms are precisely aligned relative to one another and one or more alignment tools are used to maintain the preforms in the desired alignment. An airtight structure, for example, a vacuum bag, is then placed over the entire structure. The vacuum bag has at least one opening which is in communication with a reservoir filled with resin and at least one opening which is in communication with a vacuum generating source.

In preferred embodiments, the adhesive comprises a thin film layer of adhesive which is placed between each of the surfaces of the two preforms being bonded together. The entire assembly is heated to a temperature sufficient to cause the adhesive to become viscous and to migrate (i.e., flow) into the plys or layers of each of the preforms. A vacuum force is preferably generated at this time which further assists in causing the viscous adhesive to migrate and thoroughly "wet" several plys of each of the preforms at those areas where the adhesive has been placed.

When it is determined that satisfactory wetting of the dry fiber preforms with the adhesive has occurred, resin from the resin reservoir is admitted into the airtight enclosure and drawn through each of the preforms to thoroughly wet each of the preforms. The resin substantially fills the microscopic pockets and interstices around each fiber in those plys which the adhesive has wet. This strengthens the bond line at those areas that ar being join d by th adhesive. The entire assembly is th n

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allowed to cure before being removed from the tool. Once removed, the preforms form a rigid, single piece composite laminate structure.

Advantageously, the bonding of the independent dry fiber preforms and the subsequent infusion of resin into each of the preforms can be accomplished in a single manufacturing operation. The joint produced at the bond line(s) of the preforms is enhanced due to the increased migration of the viscous adhesive into the plys of each of the preforms at those areas where bonding has taken place. The resulting joint formed at the bond line of the two preforms is stronger than what would be formed simply by adhering two otherwise completely formed preforms together because the dry fiber preforms, in connection with the heating of the preforms, allow wetting of several plys of each of the preforms at the joint area, rather than just the surface ply of each preform.

To this end, independent claim 1 recites a method for forming a composite laminate structure comprising providing a first dry fiber preform, placing a thin film adhesive material against a surface of said first dry fiber preform, placing a second dry fiber preform against said adhesive material to thereby sandwich said thin film adhesive material between said dry fiber preforms and thereby form a composite laminate assembly, each of said dry fiber preforms having a plurality of layers of fiber material, placing said composite laminate assembly within an airtight enclosure, heating said thin film adhesive material and said dry fiber preforms to a temperature sufficient to cause said thin film adhesive material to become viscous, causing said viscous adhesive to flow into a subplurality of layers of each of said dry fiber preforms to at least substantially saturate a subplurality of said layers of each of said dry fiber preforms, and after said subplurality of said layers of said dry fiber preforms

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are substantially saturated with said viscous adh sive, then infusing a resin into each of said dry fiber preforms to thoroughly wet said dry fib r preforms.

In contrast, Flonc merely discloses a process for bonding layers 1 to form a storable preform 3 which can be stored and then later cut and shaped, in separate processes, to form a composite part. See column 3, lines 17-22. Flonc clearly does not disclose a process in which two or more independent dry fiber preforms are bonded to one another to form a composite laminate structure, preferably, in a single manufacturing operation. Indeed, Flonc teaches away from a single manufacturing operation by touting advantages associated with being able to store the preform 3 for subsequent cutting and shaping processes. For these reasons alone, the rejection of claim 1 should be withdrawn.

Further, Flonc lacks any disclosure, teaching or remote suggestion of a viscous adhesive being caused to flow from opposing surfaces of dry fiber preforms (between which the adhesive material is sandwiched) into a subplurality of layers of each of the dry fiber preform to at least substantially saturate a subplurality of the layers of each dry fiber preform. In Flonc, the solid resin 4 is individually applied to between each corresponding pair of layers 1, heated and then cooled to bond the layers 1 together to form a storable bonded preform 3. See column 3, lines 17-22.

Applicants have not found any disclosure, teaching or even remote suggestion in Flonc that any portion of the resin 4 flows into or even wets any layer (yet alone substantially saturate a subplurality of layers) other than the surface of the corresponding layers 1 between which it was initially sandwiched. Indeed, FIG. 3 does not appear to show any portion of the resin 4 migrating beyond the immediate two layers 1 between which it was sandwiched. With methods of the present invention, however, the viscous adhesive flows from th surfaces of the preform to

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substantially fill th int rstices and microscopic voids around the individual fibers of at least the first s veral layers of each preform. This greater migration of adhesive into the plys strengthens the joint bonding the surfaces together.

In view of the above, applicants respectfully submit that Flonc fails to disclose, teach or even remotely suggest a method that includes "causing said viscous adhesive to flow into a subplurality of layers of each of said dry fiber preforms to at least substantially saturate a subplurality of said layers of each of said dry fiber preforms". For this reason alone, the rejection of claim 1 should be withdrawn.

Further, Flonc lacks any disclosure, teaching, or remote suggestion that "after said subplurality of said layers of said dry fiber preforms are substantially saturated with said viscous adhesive, then infusing a resin into each of said dry fiber preforms to thoroughly wet said dry fiber preforms" as recited in claim 1.

Regarding claim 2, Flonc does not disclose, teach or remotely suggest curing two or more dry fiber preforms, whereupon said composite laminate assembly is formed into said composite laminate structure. Instead, Flonc discloses placing the single, rigid preform 7 in a mold cavity 8 to cure the single, rigid preform 7 to form a part. See column 4, lines 9-18.

With respect to claim 4, Flonc does not disclose, teach or remotely suggest placing two or more dry fiber preforms within a vacuum bag. Instead, Flonc discloses placing a single bonded preform 3 and mandrel 6 within a vacuum bag. See column 3, lines 39-52.

Flonc also does not disclose, teach or remotely suggest "applying a vacuum to said vacuum bag to cause said viscous adhesive to flow into said subplurality of layers of each of said dry fiber preforms" as recited in claim 4. Instead, Flonc merely

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discloses that the vacuum bag is us d to form the preform 3 to th shape of the mandrel 6. Se column 3, lines 39-52. And, as mentioned above,

Applicants have not found any disclosure, teaching or even remote suggestion in Flonc that any portion of the resin 4 flows into or even wets any layer (yet alone substantially saturate a subplurality of layers) other than the surface of the corresponding layers 1 between which it was initially sandwiched. Indeed, FIG. 3 does not appear to show any portion of the resin 4 migrating beyond the immediate two layers 1 between which it was sandwiched. With methods of the present invention, however, the viscous adhesive flows from the surfaces of the preform to substantially fill the interstices and microscopic voids around the individual fibers of at least the first several layers of each preform. This greater migration of adhesive into the plys strengthens the joint bonding the surfaces together.

Flonc and Crane also fail to recognize the unobvious advantages (described below) that can be realized by the methods of the present invention. For example, neither reference recognizes that the joint produced at the bond line(s) of the preforms is enhanced due to the increased migration of the viscous adhesive into the plys of each of the preforms at those areas where bonding has taken place. The cited references also do not recognize that the resulting joint formed at the bond line of the two preforms is also stronger than what would be formed simply by adhering two otherwise completely formed preforms together because the dry fiber preforms, in connection with the heating of the preforms, allow wetting of several plys of each of the preforms at the joint area, rather than just the surface ply of each preform.

Additionally, neither cited reference recognizes that heating the preforms along with the adhesive has the beneficial effect of removing any residual moisture that may be contain d in the preforms which might imped th flow of the adhesive

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into th plys thereof. The cited references do not recognize that using dry fiber preforms rather than prepegs allows the adhesive to flow more easily into several plys of each of the preforms such that wetting of more than just the surface ply of each preform occurs with the present invention. This is in contrast to methods which involve heating prepregs or already completely resin cured preforms with an adhesive layer placed between surfaces to be joined, which typically only allows the outermost ply of each preform to be wetted with the adhesive. With methods of the present invention, the viscous adhesive flows and substantially fills the interstices and microscopic voids around the individual fibers of the first several plys of each preform.

Further, neither of the cited references recognize the benefit of being able to set up the dry preforms and the adhesive layer in one operation within the vacuum bag and then formed in a single molding operation, which saves significant labor and time over those methods which require the preforms to be partially or fully cured with resin before being bonded together.

Another advantage is that by using dry fiber preforms, the preforms themselves do not need to be stored in a carefully temperature controlled environment, as would typically be the case with B-staged preforms. The use of dry fiber preforms rather than B-staged preforms also means that limitations on the time during which the preforms can be stored is not a consideration, as would be the case with B-staged preforms. B-staged preforms must typically be used within a relatively short time period (typically one month or less) from the time that the B-staging has occurred. Methods of the present invention further involves less handling and human contact with the resin by workers because of the use of dry fiber preforms rather than B-staged or fully wetted preforms.

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For at least the above reasons, applicants respectfully submit that the cited references do not anticipate or render obvious claims 1, 2, and 4-6. Accordingly, th Patent Office is respectfully requested to reconsider and withdraw the section 102 and 103 rejections of claims 1, 2, and 4-6.

REJECTION OF CLAIM 3 UNDER 35 U.S.C. § 103

Claim 3 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Flonc as applied to claim 2 above and further in view of Setiabudi (U.S. Patent No. 5,840,238). This rejection is respectfully traversed.

Claim 3 depends from claim 2, which, in turn, depends from independent claim 1. Thus, claim 3 is allowable over the cited references for at least the same reasons as those presented above with respect to claims 1 and 2.

REJECTION OF CLAIMS 7-11 AND 15-17 UNDER 35 U.S.C. § 103

Claims 7-11 and 15-17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Flonc as applied in claim 1 above and further in view of Crane and McClure (U.S. Patent No. 6,555,045). This rejection is respectfully traversed.

Independent claim 7 recites a method for forming a composite laminate structure comprising providing a first dry fiber preform, placing a layer of thin film adhesive against a surface of said first dry fiber preform, placing a second dry fiber preform against said thin film adhesive layer to thereby sandwich said thin film adhesive layer between said dry fiber preforms and thereby form a composite laminate assembly, each of said dry fiber preforms having a plurality of layers of fiber material, placing said composite laminate assembly within a vacuum bag, heating said composite laminate assembly to a predetermined temp rature sufficient to

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cause said thin film adhesive layer to become viscous and to flow into a subplurality of said layers of said fiber material of each of said dry fiber preforms, to thereby at least substantially saturate said subplurality of layers, after said subplurality of said layers of said fiber material are substantially saturated with said viscous adhesive, then infusing a resin into said dry fiber preforms and using said vacuum to draw said resin through said dry fiber preforms to thoroughly wet said dry fiber preforms, and curing said composite laminate assembly to form said composite laminate structure.

Independent claim 15 recites a method for forming at least a pair of independent dry fiber preforms into a composite laminate structure, wherein each of said dry fiber preforms includes a plurality of layers of fiber material, the method comprising the steps of disposing a thin film adhesive layer between opposing surfaces of said dry fiber preforms such that said adhesive layer is sandwiched between said dry fiber preforms; placing said dry fiber preforms with said adhesive layer therebetween within a vacuum enclosure; heating said dry fiber preforms and said adhesive layer to a first temperature sufficient to cause said adhesive layer to become viscous; applying a vacuum to said vacuum enclosure to cause said viscous adhesive to flow into a subplurality of said plurality of layers of said fiber material of each of said dry fiber preforms to substantially saturate said subplurality of said plurality of layers; waiting a period of time for said dry fiber preforms to cool down to a second temperature; once said dry fiber preforms reach said second temperature, using said vacuum to draw resin from a resin reservoir in communication with said vacuum enclosure through said dry fiber preforms to thoroughly wet said dry fiber preforms; and after said dry fiber preforms have been thoroughly wetted by said resin, further heating said dry fiber preforms to a third temperature greater than said

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first temperatur to cure said pr forms, whereupon curing said dry fiber preforms are bonded to one another to form said composite laminate assembly.

As described in detail above, however, Flonc merely discloses a process for bonding layers 1 to form a storable preform 3 which can be stored and then later cut and shaped, in separate processes, to form a composite part. See column 3, lines 17-22. Flonc clearly does not disclose a process in which two or more independent dry fiber preforms are bonded to one another to form a composite laminate structure, preferably, in a single manufacturing operation. Indeed, Flonc teaches away from a single manufacturing operation by touting advantages associated with being able to store the preform 3 for subsequent cutting and shaping processes. For these reasons alone, the rejection of claim 7-11 and 15-17 should be withdrawn.

Further, Flonc lacks any disclosure, teaching or remote suggestion of a viscous adhesive being caused to flow from opposing surfaces of dry fiber preforms (between which the adhesive material is sandwiched) into a subplurality of layers of each of the dry fiber preform to at least substantially saturate a subplurality of the layers of each dry fiber preform. In Flonc, the solid resin 4 is individually applied to between each corresponding pair of layers 1, heated and then cooled to bond the layers 1 together to form a storable bonded preform 3. See column 3, lines 17-22.

Applicants have not found any disclosure, teaching or even remote suggestion in Flonc that any portion of the resin 4 flows into or even wets any layer (yet alone substantially saturate a subplurality of layers) other than the surface of the corresponding layers 1 between which it was initially sandwiched. Indeed, FIG. 3 does not appear to show any portion of the resin 4 migrating beyond the immediate two layers 1 between which it was sandwiched. With methods of the present invention, however, the viscous adhesiv flows from the surfaces of th preform to

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substantially fill the interstices and microscopic voids around the individual fibers of at least the first sev ral layers of each preform. This gr ater migration of adhesive into the plys strengthens the joint bonding the surfaces together.

In view of the above, applicants respectfully submit that the cited references fail to disclose, teach or even remotely suggest a method that includes "heating said composite laminate assembly to a predetermined temperature sufficient to cause said thin film adhesive layer to become viscous and to flow into a subplurality of said layers of said fiber material of each of said dry fiber preforms, to thereby at least substantially saturate said subplurality of layers" as recited in claim 7; or "applying a vacuum to said vacuum enclosure to cause said viscous adhesive to flow into a subplurality of said plurality of layers of said fiber material of each of said dry fiber preforms to substantially saturate said subplurality of said plurality of layers" as recited in claim 15. For these reasons alone, the rejection of claims 7-11 and 15-17 should be withdrawn.

Given that Flonc, Crane, and McClure fail to even remotely disclose or suggest the methods steps recited in claims 7-11 and 15-17, the rejection of these claims should be withdrawn. For these reasons, the Patent Office is respectfully requested to reconsider and withdraw the § 103 of claims 7-11 and 15-17.

REJECTION OF CLAIMS 12-14 UNDER 35 U.S.C. § 103

Claims 12-14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Flonc, Crane and McClure as applied to clam 7 above and further in view of Setiabudi. This rejection is respectfully traversed.

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Claims 12-14 depend from claim 7 and are therefor allowable over the cited references for at least the same reasons as those presented above with respect to claim 7.

<u>REJECTION OF CLAIM 18 UNDER 35 U.S.C. § 103</u>

Claim 18 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Flonc, Crane and McClure as applied to clam 15 above and further in view of Setiabudi. This rejection is respectfully traversed.

Claim 18 depends from claim 15 and is therefore allowable over the cited references for at least the same reasons as those presented above with respect to claim 15.

<u>CONCLUSION</u>

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will

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expedite prosecution of this application, the Examiner is invited to telephone the undersigned directly at (314) 726-7502.

Respectfully submitted,

Dated: ____________________

By: ____________________
Anthony G. Fussner, 47,582

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